

2015 City of Denton Municipal Operations

Record	Scope	Contact	Pg.
BUILDINGS AND FACILITIES			
Buildings and Facilities, Electricity - DME	2	Katherine Barnett, Sustainability and Special Projects Administrator, City of Denton	
Buildings and Facilities, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ	
Buildings and Facilities, Electricity - Oncor	2	Customer Service, Oncor	
Buildings and Facilities, Natural Gas - Atmos Energy	1	Stacey Medford, Atmos Energy; Melanie Beard, Accounts Payable Supervisor, City of Denton	
STREETLIGHTS AND TRAFFIC SIGNALS			
Streetlights, Electricity - DME	2	Rich Selmi, System and Operations Administrator, DME	
Streetlights, Electricity - Oncor	2	Customer Service, Oncor	
Traffic Signals, Electricity - DME	2	Cynthia Williams, Business Information Analyst, City of Denton	
VEHICLE FLEET			
Vehicle Fleet	1	Charles Rosendahl, Fuel Specialist, City of Denton	
EMPLOYEE COMMUTE			
Employee Commute	3	Lisa Manning, Human Resources, City of Denton	
ELECTRIC POWER PRODUCTION			
T & D Losses	2	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME	
SOLID WASTE			
Solid Waste, Landfill	1	Ami Reeder, Regulatory Compliance Manager, City of Denton	
Solid Waste, Municipal Waste	3	Tina Ek, Financial Administrator, City of Denton	
Solid Waste, Electricity - DME	2	Katherine Barnett, Sustainability and Special Projects Administrator, City of Denton	
WATER AND WASTEWATER TREATMENT FACILITIES			
Water Supply, Electricity - DME	2	Katherine Barnett, Sustainability and Special Projects Administrator, City of Denton	
Water Supply, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ	
Water Supply, Natural Gas - Atmos Energy	1	Stacey Medford, Atmos Energy; Melanie Beard, Accounts Payable Supervisor, City of Denton	
Wastewater, Electricity - DME	2	Katherine Barnett, Sustainability and Special Projects Administrator, City of Denton	

APPENDIX. 2015. Community and City of Denton Municipal Operations. Data and Calculations.

Wastewater, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ
Wastewater, Electricity - Oncor	2	Customer Service, Oncor
Wastewater, Natural Gas - Atmos Energy	1	Stacey Medford, Atmos Energy; Melanie Beard, Accounts Payable Supervisor, City of Denton
Wastewater, Incomplete Combustion of Waste Gas	1	Rusty Ward, Water Reclamation Superintendent, City of Denton
Wastewater, Combustion in Heat Exchanger	1	Rusty Ward, Water Reclamation Superintendent, City of Denton
OTHER		
Electricity Emission Factors	-	Jim Maynard & Elizabeth Ruiz, DME; Art Diem, USEPA; Environmental Consultants, Burns & McDonnell
Transportation Emission Factors	-	Vivek Thimmavajjala, Transportation System Modeler, NCTCOG
City Employees	-	Lisa Manning, Human Resources, City of Denton
Population	-	US Census

2015 City of Denton Community Scale

Record	Scope	Contact	Pg.
RESIDENTIAL			
Residential, Electricity - DME	2	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME	
Residential, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ	
Residential, Electricity - Oncor	2	Richard Sorell, Director of Consumer Affairs, Oncor	
Residential, Natural Gas - Atmos Energy	1	Stacey Medford, Atmos Energy	
COMMERCIAL			
Commercial, Electricity - DME	2	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME	
Commercial, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ	
Commercial, Electricity - Oncor	2	Richard Sorell, Director of Consumer Affairs, Oncor	
Commercial, Natural Gas - Atmos Energy	1	Stacey Medford, Atmos Energy	
INDUSTRIAL			
Industrial, Electricity - DME	2	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME	
Industrial, Electricity - CoServ	2	Charlotte Jolly, C&I Representative, CoServ	

APPENDIX. 2015. Community and City of Denton Municipal Operations. Data and Calculations.

TRANSPORTATION		
Community VMT	1	Samuel Simmons, Transportation Planner, NCTCOG
WATER AND WASTEWATER		
Wastewater, Incomplete Combustion of Waste Gas	1	Rusty Willard, Water Reclamation Superintendent, City of Denton
Wastewater, Combustion in Heat Exchanger	1	Rusty Willard, Water Reclamation Superintendent, City of Denton
SOLID WASTE		
Solid Waste, Landfill	1	Ami Reeder, Regulatory Compliance Manager, City of Denton
ELECTRIC POWER PRODUCTION		
T & D Losses	3	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME
OTHER		
Electricity Emission Factors	-	Elizabeth Ruiz, Energy Programs Coordinator, DME; Jim Maynard, Energy Project Development Manager, DME
Transportation Emission Factors	-	Vivek Thimmavajjhala, Transportation System Modeler, NCTCOG
Population	-	US Census

Municipal Electric Summary

2015

Katherine Barnett, Sustainability and Special Projects Administrator, City of Denton

Charlotte Jolly, C&I Representative, CoServ
Customer Service, Oncor

For 2015, all electricity consumption pertaining to facilities and operations for Solid Waste, Water Supply, Wastewater Treatment, or Streetlights, are reported under these categories; all other municipal electric consumption is reported under Buildings and Facilities. Buildings associated with Solid Waste had previously been reported with Buildings and Facilities. The summary table below is the result of a comprehensive data collection from each of our three utility providers, including individual department analysis of electric meter location and function. Electricity for most City facilities is provided by **DME**. The City tracks all **DME** consumption, except for some unmetered Street Lights and Traffic Signals, through the Northstar System. **CoServ** provides electricity to some Buildings and Facilities, Water Supply and Wastewater. **Oncor** provides electricity to some Buildings, Streetlights and Wastewater. Unmetered Streetlights and Traffic Signals are reported separately.

Municipal Electricity (in kWh's)				
Category	DME	CoServ	Oncor	Total
Buildings & Facilities	14,690,145.00	1,197.00	14,531.00	14,705,873.00
Streetlights	17,072.00	-	7,800.00	24,872.00
Water Supply	10,401,674.00	5,587,988.00	-	15,989,662.00
Wastewater	10,586,552.79	499,394.00	238,058.00	11,324,004.79
Solid Waste	622,828.00	-	-	622,828.00
Total	36,318,271.79	6,088,579.00	260,389.00	42,667,239.79

Municipal Traffic Signals (Unmetered) Summary

2015

Cynthia Williams, Business Information Analyst, City of Denton

Traffic Signals are billed by historical average kWh's at each intersection per year. We were provided the total annual charges for Traffic Signals, as well as the DME kWh rate for traffic signals. Consumption was estimated by the following equation:
(DME Total Charges / DME kWh Rate)

Energy Consumed (in kWh's)		
Total Cost	kWh Rate	Estimated kWh/yr.
\$ 5,614.65	\$ 0.0603	93,111.94

Municipal Streetlights (Unmetered) Summary

2015

Rich Selmi, System and Operations Administrator, DME

Most City Streetlights are unmetered and therefore billed by the utility based on an estimated kWh/yr consumption factor. City staff has provided streetlight counts by bulb wattage. Estimated kWh/yr is calculated as follows:

$$(((\text{\# of Lights} * \text{Wattage of Light}) * 12 \text{ hours}) * 365 \text{ day}) / 1,000$$

DME			
Source	# of Lights	Wattage of Lights	Estimated kWh/yr
DME Streetlight	5,702.00	100.00	2,497,476.00
DME Streetlight	1,469.00	250.00	1,608,555.00
DME Streetlight	38.00	400.00	66,576.00
Total	7,209.00		4,172,607.00

Municipal Natural Gas Summary

2015

Stacey Medford, Atmos Energy

Melanie Beard, Accounts Payable Supervisor, City of Denton

Natural Gas is the primary source of space and water heating for City facilities. Since 2005, Atmos Energy has been the provider of natural gas to the City. Original data is from paper billings, calculated in a spreadsheet, and summarized by departmental category in the chart below. Two units of measure (MCF and mmBTU) are provided to effectively quantify all affiliated GHG emissions based on the amount of energy consumed at each meter. According to EIA in 2015, the average heat content of Natural Gas was 1.032 (the factor we used to convert MCF to mmBTU below) .

Atmos Energy		
Category	MCF	mmBTU
Buildings	20,937.90	21,607.91
Water Supply	124.80	128.79
Wastewater	1,546.00	1,595.47
Total	22,608.70	23,332.18

Landfill Gas

2015

Ami Reeder, Regulatory Compliance Manager, City of Denton

The U.S. Community Protocol, V. 1, released in October 2012, recommends that Community's which own and manage their own landfill (like Denton), and report annually to the USEPA's Mandatory GHG Reporting Program, use the same methods here. The City of Denton's Landfill has reported annually to the USEPA's Mandatory GHG program since 2010. Consultant Weaver Boos has produced the data for us to conduct these reports. Per protocol recommendations, we used HH-6 for this year's GHG Inventory (previously used HH-8) because it was the greater of the two sums.

HH-6 Equation Summary	
Methane Emissions= $[(GCH_4 - R) * (1 - OX) + R * [1 - (DE * f_{Dest})]]$	
G_{CH_4} =	Modeled methane generation rate
R=	Quantity of recovered CH ₄
OX=	Oxidation fraction, .10 (10% methane oxidation in cover soils)
DE=	Destruction efficiency
f_{Dest} =	Fraction of hours the destruction device operated

HH-6 Equation Results	
Methane Emissions= $[(GCH_4 - R) * (1 - OX) + R * [1 - (DE * f_{Dest})]]$	
1,817.17	Metric Tons CH ₄
38,160.57	Metric Tons CO ₂ e

Municipal Waste

2015

Tina Ek, Financial Administrator, City of Denton

The refuse number is an estimate and is based on quantity, size and frequency of waste pickup at City facilities (x12 for the year). ICLEI provided a conversion factor based on the typical weight per cubic yard of un-compacted commercial and industrial waste, to convert cubic yards to pounds. National averages for local government waste stream shares were applied to the weight collected.

Breakdown of Waste		
Type	%	Source
Percentage Newspaper	5.5%	CIWMB
Percentage Office Paper	22.0%	CIWMB-cons
Percentage Corrugated Cardboard	4.6%	CIWMB
Percentage Magazines / Third Class Mail	6.0%	CIWMB-cons
Percentage Food Scraps	13.0%	original 2003
Percentage Grass	3.0%	2003 divided
Percentage Leaves	4.0%	""
Percentage Branches	3.0%	""
Percentage Dimensional Lumber	4.0%	Original 2003
Other	35.0%	

Summary of Waste	
Metric	Total
Cubic Yards Collected/yr:	17,641.00
Converted to lbs = cubic yards x 600	10,584,600.00
Converted to metric tons = lbs x 0.00045359	4,801.07

Municipal Employee Commute Summary

2015

Lisa Manning, Human Resources, City of Denton

The City maintains a list of all employees and their residential zip code. The total # of employees residing per zip code was multiplied by the daily round trip distance from the residential zip code to city center (76201-where most City offices are located). Employees driving a distance > 70 miles one way were assumed to not be regular commuters and were excluded from the final calculations. It should be noted that in previous GHG Inventories this assumption was based on distances > 160 miles one way. The daily employee trip distances were summed for each zip code, and multiplied x 260 working days/year. We also assumed all passenger vehicles consumed unleaded gasoline.

Miles Driven				
# of Employees	Total Daily	Total Annual	Average Daily	Average Annual
1,557.00	33,168.20	8,623,732.00	21.30	5,538.68

Municipal Vehicle Fleet Summary

2015

Charles Rosendahl, Fuel Specialist, City of Denton

Fleet Services tracks the quantity of fuel used by each vehicle and fuel type. Working within the category framework of the ClearPath software, Fleet Services summarized the total consumption of fuel (in gallons) by each of the following categories. Although the city has begun to record miles driven per vehicle, due to an assumed likelihood of human input error this data set was not considered reliable. As done previously, we estimated an average MPG per category to calculate total miles driven with the provided gallons consumed.

Total Fuel Consumption (in Gallons)				
Category	B20 Diesel	B5 Diesel	Ethanol	Unleaded
Heavy Duty	1,381.01	36,359.78	-	995.53
Heavy Truck	190,292.51	47,014.90	-	-
Light Duty	222.49	2,749.00	1,306.00	42,566.74
Light Truck	21,942.58	91,582.63	13,139.15	175,788.57
Motorcycle	-	-	418.50	3,578.33
Off Road Agriculture	2,009.16	2,878.90	-	5.20
Off Road Construction	110,738.05	9,501.90	-	257.30
Off Road Small Utility	219.29	18.40	-	112.60
Off Road Utility	1,450.39	24.30	4.31	254.20
Total	328,255.48	190,129.81	14,867.96	223,558.47

Wastewater Fugitive Emissions

2015

Rusty Willard, Water Reclamation Superintendent, City of Denton

The City tracks daily digester gas produced. Water Reclamation provided data for total daily digester gas collected, as well as gas used for heating digesters and open flared (waste gas) for 2015. A review of City data from 2015 shows that, on average, approximately 29 percent of the digester gas is used to heat the digesters and 71 percent is flared as waste gas. Based on current protocols (in ClearPath), Equation 10.1 for Incomplete digestion (LGOP 2010) was applied to 71 percent of the gas totals for 2015. ClearPath applies equation WW.1 a or WW.2.a. of Community Protocol to the remaining 21%.

Annual CH₄ emissions (metric tons CO₂e)=(Digester gas in ft³/day x FCH₄ x p(ch₄) x (1-DE) x .0283 x 356.25 x 10⁻⁶) x GWP

Digester Gas Summary			
Unit of Measure	MCF/yr	ft ³ /yr	ft ³ /day
Total Gas Collected	49,414.56	-	-
Waste Gas Combustion	-	35,003,940.00	95,835.56
Heat Exchanger Utilization	-	14,410,620.00	39,454.13

Community Electric Summary

2015

Jim Maynard, Energy Project Development Manager, DME

Elizabeth Ruiz, Energy Programs Coordinator, DME

Charlotte Jolly, C&I Representative, CoServ

Richard Sorell, Director of Consumer Affairs, Oncor

The summary table below is the result of a comprehensive data collection from each of our three utility providers. Electricity for most of the City is provided by **DME**. **CoServ** and **Oncor** provide electricity to some customers as indicated below.

Community Electricity (in MWh's)				
Category	DME	CoServ	Oncor	Total
Commercial	318,104.00	28,412.43	4,369,021.00	4,715,537.43
Residential	571,555.00	45,460.70	16,737,906.00	17,354,921.70
Industrial	568,508.00	33,490.11	-	601,998.11
Total	1,458,167.00	107,363.24	21,106,927.00	22,672,457.24

Community Natural Gas Summary

2015

Stacey Medford, Atmos Energy

Atmos Energy provided community-wide natural gas sales data by two sectors: Residential and Commercial & Industrial. To calculate total Community Commercial & Industrial consumption we subtracted the Municipal natural gas consumption figures (summarized under the Municipal section of this report). According to EIA, in 2015 the average heat content of Natural Gas was 1.032.

Atmos Energy			
Category	MCF	mmBTU Equivalent	% of Total
Residential	982,790.66	1,014,239.96	51%
commercial & Industrial	929,776.26	959,529.10	49%
Sub-Total	1,912,566.92	1,973,769.06	100%

Category	C&I mmBTU	COD mmBTU	Total C&I
C&I (excluding COD)	959,529.10	23,216.70	936,312.40

Community Vehicle Miles Traveled (VMT)

2015

Samuel Simmons, Transportation Planner, NCTCOG

Community transportation emissions estimates are based on community vehicle miles traveled and transportation emissions factors. The emissions factors are based on: percentage of vehicle type on road, by fuel for inventory year, and fuel efficiency. This information originated from USEPA data. We have used this methodology for each of our inventoried years. Daily VMT for 2015 was provided by NCTCOG. This data is based on the Metropolitan Transportation Plan for North Central Texas, Mobility 2035 – 2014 Amendment. It was generated from NCTCOG's regional travel demand model and reflects forecasted data, not observed data. Also, this information applies to an approximate area of the City of Denton, as the model's traffic survey zone structure does not precisely match city limits. NCTCOG planners have estimated that 23% of freeway traffic is pass-through traffic in Denton.

Breakdown of Community Vehicles	
Vehicle Type	% of VMT
Passenger Unleaded	60.0%
Light Truck Unleaded	32.4%
Passenger Diesel	12.0%
Light Truck Diesel	5.4%
Heavy Truck Diesel	0.3%

NCTCOG Data on Annual VMT for Denton Area		
Inventory Year	2011	2015
NCTCOG Model:	Mobility 2035, 2013	Mobility 2035, 2014
Average Daily Total VMT:	4,236,732.00	4,381,699.00
Average Daily Freeway VMT:	1,892,239.00	1,941,901.00
% of Freeway Traffic That Is Pass-Through:	23%	23%

Calculated Based On NCTCOG Data		
Inventory Year	2011	2015
Average Annual VMT:	1,546,407,180.00	1,599,320,135.00
% of TOTAL Daily VMT that is Freeway VMT:	45%	44%
Daily Pass Through VMT:	435,214.97	446,637.23
% of VMT represented by pass through traffic*:	10%	10%

Electricity Emission Factors

2015

Jim Maynard, Energy Project Development Manager, DME

Elizabeth Ruiz, Energy Programs Coordinator, DME

Art Diem, USEPA

Environmental Consultants, Burns & McDonnell

Electricity emissions factors are the amount of various pollutants emitted, usually from fuel combustion, per unit of electricity produced. Average emissions factors for a given utility depend on the mix of fuel and power plant types, plant efficiencies, and pollutant control technologies used. The USEPA's eGRID program maintains emissions factors by plant type and by utilities and regions in the U.S. USEPA staff has worked with City staff to provide DME specific emissions factors, for each City inventory. For 2015, USEPA data from the eGRID program and from Burns McDonnell, consultant, was used. For DME's mix the emissions factors were proportionally applied to kWh purchased from each fuel type in DME's mix (coal, market, landfill gas, wind). Most of the City's electricity is provided by DME, with some municipal and private accounts being serviced by CoServ or Oncor. Regional emissions factors (for ERCOT) have been applied to Scope 2 emissions (purchased electricity) from CoServ and Oncor.

Emission Factors Summary					
Source	Year	CO2 lbs/MWh	CH4 lbs/MWh	N2O lbs/MWh	CO2e lbs/MWh
ERCOT	2012	1,307.00	0.0167	0.0123	1,311.08
DME	2015	1,025.13	0.0120	0.0136	1,029.48

Transportation Emission Factors

2015

Vivek Thimmavajhala, Transportation System Modeler, NCTCOG

Transportation emissions factors represent the amount of pollutant generated per vehicle mile travelled. Emissions result from fuel combustion, and will vary with vehicle class, model year/efficiency, and pollution control technologies. Average emissions factors for a region reflect the general make-up of on road vehicles by class, age, etc. Two sources of data were used to populate Transportation Emission Factor set in ClearPath - fuel economy and emissions per mile travelled for the mix of vehicle types estimated to be on the road for North Texas. Fuel economy factors were sourced from a national polling through Alternative Fuels Data Center (AFDC), while the emissions were sourced regionally through NCTCOG.

Emission Factors Summary			
Classification	MPG	CH4/mi	N20/mi
Light Duty - Unleaded	21.600	0.003	0.004
Light Truck - Unleaded	17.200	0.007	0.013
Heavy Truck - Unleaded	5.300	0.007	0.023
Transit Bus - Unleaded	3.300	0.015	0.034
Para Transit Bus - Unleaded	3.300	0.101	0.044
Motorcycle - Unleaded	43.500	0.027	0.006
Light Duty - Diesel	23.900	0.003	0.001
Light Truck - Diesel	19.000	0.013	0.004
Heavy Truck - Diesel	5.800	0.047	0.006
Transit Bus - Diesel	3.600	0.025	0.005
Para Transit Bus - Diesel	3.600	0.026	0.005

T&D Losses

2015

Jim Maynard, Energy Project Development Manager, DME

Elizabeth Ruiz, Energy Programs Coordinator, DME

T&D losses were calculated as the difference between electricity purchased and electricity sold by DME.

DME Electricity Summary			
MWh Purchased	MWh Sold	T&D Losses	MWh Losses
1,529,578.00	1,458,167.00	4.897%	71,411.00

Other Inputs

Lisa Manning, Human Resources, City of Denton

City Employees		
Year	Total	Source
2015	1,557.00	City of Denton

Population		
Year	Total	Source
2015	131,044.00	US Census (V2015)